

**REMARKS*****I. Amendments to the Specification:***

Amendments made to the present specification serve to correct minor inconsistencies in the invention's description and in accordance with 37 C.F.R. §1.121 introduce no new matter.

***II. Claims Status:***

Claims 8 and 22-46 have been canceled.

Claims 1, 10-21 have been amended.

Claims 1-7 and 9-21 are currently pending.

***III. Affirmation of Prior Election of Invention and Cancellation of Claims 30-46***

Applicant hereby affirms the prior election of Group I, claims 1-29, made in applicant's December 2, 2002 "Response to Restriction Requirement" in this patent application.

Consistent with the Examiner's withdrawal of claims 30-46, in the March 21, 2003 Office Action, claims 30-46 have been cancelled herein, with the express reservation of the right to file divisional application(s) directed to the subject matter thereof, during the pendency of the present application, or during the pendency of a further divisional or continuing application based on and claiming the priority of the present application.

***IV. Response to Claim Rejections Under 35 U.S.C. § 112***

In the March 21, 2003 Office Action, claims 1-29 were rejected under 35 U.S.C. § 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.. Set forth below is the basis for the rejections as well as applicant's response to same.

Patent Application 10/015,326  
ATMI-515

- (a) the steps (1) and (2) in the Markush grouping recited in e.g. in claims 1 and 29 are directed to two unrelated, different units of operation, i.e. to absorption and distillation.

In response applicant has amended claim 1 to delete all reference to the distillation aspect of the present invention.

- (b) For the combination (3), there is no tie-in between step (1) and step (2). The product from step (1) is also not connected or correlated to step (2) and vice versa.

In response applicant has amended claim 1 to delete all reference to the step (2) aspect of the present invention.

- (c) The use of abbreviations in the claims is improper. For example "CVD" in claims 1 and 2.

In response, applicant has amended claim 1 by inserting the term "chemical vapor deposition" followed by the abbreviation "CVD" in parenthesis.

- (d) The inconsistent use of terminology in the claims is improper such as e.g., "optionally at least one other impurity" in claim 1, line 4; "or optionally at least one impurity in line 1, as opposed to "optionally impurity" in line 5. In claim 13, the "adsorbent" in claim 13 should be-adsorbent bed material--.

In response, applicant amends, claim 1 to cite the limitation "at least one impurity" consistently within the text of the claim and claim 13 to correctly identify the term "adsorbent" as "adsorbent bed material".

- (e) The "n" in  $[\text{SiO}]_n$  recited in claim 1, (2) was not specified in the claim.

In response applicant has amended claim 1 to delete all reference to the step (2) aspect of the present invention, which included the formula  $[\text{SiO}]_n$ .

- (f) The process steps (1) and (2) are already covered in claim 1, claimed twice and/or at odds with claim 1, steps (1) and (2)?

In response applicant has amended claim 1 and deleted claim 8 to delete all reference to the step (2) aspect of the present invention, and to correct redundancy issues in the present claims.

- (g) An "azeotropic mixture" is normally defined by its composition and pressure, but which parameters are not given in the claims. See e.g. claim 1, (2).

In response applicant has amended claim 1 to delete all reference to the step (2) aspect of the present invention.

- (h) It is unclear what "said impurity" is being referred to in claims 2-4, i.e., whether the initially recited "at least one impurity" or "the at least one other impurity".

In response, applicant has amended claim 1 to cite the limitation "at least one impurity" consistently within the claim's text.

- (i) It is not clear whether the "an adsorbent bed material" in claim 8, line 2, is the same or different from the "an adsorbent bed material" initially in claim 1, line 3.

Applicant has herein canceled claim 8, thus obviating section (i) of the present 35 USC §112, second paragraph rejection.

- (j) The claimed "said drying agent" in claim 10 lacks antecedent basis for support in the claims. The same hold true for claims 11, 12, 14, and 17.

In response, applicant has amended claims 11, 12, 14 and 17 by deleting all reference to "drying agent".

- (k) The decantation in claim 16 is at odds with the distillation in combination of (1) and (2) for (3) step.

In response applicant has amended claim 1 to delete all reference to steps (2) and (3) of the present invention.

- (l) Regarding claim 10, the phrase "such as" renders the claim indefinite because it is unclear whether the limitations following the phrase are part of the claimed invention.

In response applicant has amended claim 10 to delete the phrase "such as calcium hydride".

The aforementioned amendments serve to overcome the sections (a) – (l) rejections under 35 U.S.C. §112, second paragraph, as set forth in the March 21, 2003 Office Action. Accordingly, applicant respectfully requests withdrawal of the rejection and reconsideration of claims 1-7 and 9-21.

**V. Claims Rejections Under 35 U.S.C. § 103(a)**

In the March 21, 2003 Office Action claims 1-29 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 4,127,598 to McEntee, et al., (hereinafter referred to as "McEntee") or U.S. Patent No. 5,312,947 to Tsukuno et al., (hereinafter referred to as "Tsukuno") in view of U.S. Patent No. 4,087,448 to Rossmly et al., (hereinafter referred to as "Rossmly").

Applicant submits that McEntee or Tsukuno in view of Rossmly does not render applicant's claimed invention *prima facie* obvious and reconsideration of the patentability of pending claims 1-7 and 9-21 is therefore requested, in light of the following remarks.

The present invention relates to a process for reducing the concentration of impurities in cyclosiloxane, low-dielectric constant precursors, to minimize and/or prevent their premature decomposition during a chemical vapor deposition process. More specifically, the present invention is directed to a process for reducing the concentration of water and optionally at least one

impurity, from a cyclosiloxane precursor, comprising contacting the cyclosiloxane precursor with an adsorbent bed material, to remove at least a portion of the water, and optionally the impurity, to thereby produce a purified cyclosiloxane precursor having a reduced level of water and impurity.

The present invention advantageously provides cyclosiloxanes suitable for semiconductor device manufacturing applications, by removing water and/or acidic and/or basic impurities, which cause their catalytic premature decomposition during chemical vapor deposition processes, as taught in the present application, on page 8,

**In the CVD process, a precursor is delivered to a CVD reactor in vapor form. In the case of solids and liquids, this requires heating of the delivery lines, CVD chamber and substrate. It is speculated that, cyclosiloxanes, particularly TMCTS, prematurely polymerize in the heated delivery lines due to the presence of trace water and/or other trace impurities such as acidic or basic impurities, in the bulk cyclosiloxane material, through a ring opening mechanism. The water and/or other impurities most probably originate from the synthetic process used to produce the cyclosiloxanes, as described hereinabove.**

According to MPEP 2142:

**To establish a *prima facie* case of obviousness, *three* basic criteria *must* be met. First, there must be some suggestion or motivation, either in the references them-selves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based on applicant's disclosure. *In re Vaack*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).**

McEntee is directed to the purification and removal from silanes and siloxanes of biphenyls and chlorinated biphenyls by contacting the silane or siloxane with an adsorbent bed in which the bed is formed from molecular sieves or charcoal (column 5, line 42), and repeatedly teaches, that the silane or siloxane to be purified must not poison the adsorbent bed, e.g., column 5, lines 26-30,

Generally, any silane and siloxane, which does not poison the adsorbent bed and has a sufficient flow viscosity to be processed through the adsorbent bed can be purified by the instant process to remove biphenyls from it. Other siloxanes that may be purified by the instant process are cyclicpolysiloxanes, tetrasiloxanes, pentasiloxanes and etc. An example of cyclic compounds are such as octamethyltetracyclicsiloxanes and octaphenyltetracyclic-siloxanes.

McEntee fails to teach or suggest a process for reducing water concentration in cyclosiloxanes, but rather teaches a process for removing from silanes and siloxanes, toxic, organic impurities identified specifically as biphenyls, chlorinated biphenyls, aromatic hydrocarbons, carbon tetrachloride and/or vinyl chloride, in order to reduce the risk of human exposure to such chemicals.

Tsukuno is directed to a method of removing ionic crystals from crude siloxanes where exemplary ionic crystals are defined as "solids of electrolyte salts" (column 3, lines 55-56). The ionic crystals contained in the crude siloxane are dissolved in "a polar solvent such as water, dimethyl sulfoxide and methanol and the solvent is then evaporated therefrom" (column 2, lines 57-59).

Rossmly is directed to a process for attaching organosulfonic acid groups to silicon through a process, which includes "reacting organopolysiloxanes with organosulfonic acid, while splitting off and removing water" (column 3, lines 47-49). Rossmly teaches that "the inventive process obviously depends on splitting siloxane bonds with the organosulfonic acid" (column 3, lines 49-51).

A basic consideration, which applies to all obviousness rejections, lies in MPEP 2141.01 (B), "The references must be considered as a whole and must suggest the desirability and thus the obviousness of making the combination".

Both Rossmly and Tsukuno teach away from the present invention, as applicant's process serves to prevent the occurrence of ring-opening mechanisms (splitting of Si-O bonds) in cyclosiloxane molecules, as sought by Rossmly, and the recrystallization of ionic crystals by dissolution (addition) in water as sought by Tsukuno.

Further Rossmly teaches the addition of sulfonic acids to promote the splitting of Si-O bonds, which is contrary to the present invention where water, acidic and basic impurities are removed in order to stabilize the cyclosiloxane molecule from catalytic ring opening mechanisms.

In evaluating the prior art references, a hypothetical combination of Rossmly with McEntee or Tsukuno is improper, for such combination is inconsistent with the express teaching of the present invention and can only be based on an impermissible reconstructive perspective of hindsight.

The Examiner states in the March 21, 2003 Office Action,

**To incorporate Rossmly's process to the process of either McEntee or Tsukuno would have been obvious to one of ordinary skill in the art inasmuch as McEntee for e.g., suggest a purification process which includes distillation. Note. e.g., col. 9, lines 38-63 and col. 12.**

Based on MPEP 2143.01 "The proposed modification cannot render the prior art unsatisfactory for its intended purpose".

Applicant's invention teaches a process for the removal of water and acidic and/or basic impurities from cyclosiloxanes to prevent their catalytic premature decomposition during a chemical vapor deposition process. The impurities removed by McEntee are organic, toxic, and aprotic, in contrast to applicant's invention for the removal of water, which is non-toxic, protic and inorganic. Accordingly, what motivation would there be for one of ordinary skill in the art to modify McEntee's purification method for removing organic, toxic, and aprotic impurities, based on Rossmly's acid catalyzed process of splitting Si-O bonds to arrive at applicant's process for removing water, acidic and basic impurities, to **prevent (emphasis added)** the premature, catalyzed decomposition reaction of cyclosiloxanes during a chemical vapor deposition process.

Rossmly teaches the distillation of a toluene/water azeotrope from a hydrolysis reaction of dichlorodimethylsilane and perfluorobutanesulfonic acid (column. 9, lines 38-63 and col. 12). The removal of the water/toluene azeotrope shifts the equilibrium reaction between dichlorodimethylsilane and perfluorobutanesulfonic acid in the direction of the sulfanated silane.

Applicant submits that incorporation of Rossmly's process into McEntee's, would render McEntee's process for removing toxic impurities such as biphenyls, aromatics, carbon tetrachloride and vinyl chloride, from silanes and siloxanes, unsatisfactory for its intended purpose as Rossmly teaches distillation of a toluene/water azeotrope from a reaction mixture that includes acids and water not biphenyls, aromatics, carbon tetrachloride and vinyl chloride. The Examiner is relying on a single aspect of Rossmly, for combination with McEntee.

Moreover, because, Rossmly teaches away from the present invention and because modification of McEntee's process based on Rossmly's azeotropic distillation would render McEntee's process unsatisfactory for its intended purpose, the combination of the references as set forth herein is wholly improper.

Neither McEntee nor Tsukuno in combination with Rossmly provides the motivation necessary to arrive at applicant's invention with any reasonable expectation of success. Accordingly, absent a suggestion or motivation to combine the references, applicant respectfully requests the withdrawal of the present 35 U.S.C. § 103(a) rejections and reconsideration of all currently pending claims

**VI. Petition Under 37 CFR 1.136 for Three-Month Extension of Time**

Petition hereby is made under the provisions of 37 CFR 1.136 for a three month extension of the term for response to the March 21, 2003 Office Action, extending the term for response to September 21, 2003.

**VI. Fees Due and Payable**

In connection with applicant's Petition Under 37 CFR 1.136 for Three Month Extension of Time, a fee of \$930 as specified in 37 CFR 1.17(a)(3), is hereby authorized to be deducted from the Deposit Account No. 50-0860 in the name of applicant, Advanced Technology Materials, Inc., 7 Commerce Drive, Danbury, CT 06810.



Patent Application 10/015,326  
ATMI-515

Should the Office determine any additional fees are due in connection with the entry of this amendment, the Office is hereby authorized to deduct such fee from applicant's above referenced Deposit Account.

**CONCLUSION**

Applicants have now made an earnest attempt to place this case in condition for allowance. For the foregoing reasons and for other reasons clearly apparent, Applicants respectfully request reexamination and reconsideration of this application and full allowance of claims 1-7 and 9-21.

In the event that any issues remain outstanding, incident to the formal allowance of the Application, the Examiner is requested to contact the undersigned agent at (203) 794-1100 ext. 4184 to discuss their resolution, so that this application may be passed to issue at an early date.

Date: September 17, 2003

Respectfully submitted,



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